

XII.—On some *Ectoparasitic Rotatoria* of the Bay of Naples. By LUDWIG PLATE*.

[Plate VI.]

THERE are referred to the Rotatoria certain forms which depart widely from the ordinary type of this class and which have this in common in their mode of life, that they live as ectoparasites upon the marine Phyllopodiform genus *Nebalia*. Hitherto two different genera of these animalcules have been known, one of which was discovered by Grube † and introduced into science under the name of *Seison*. Subsequently Claus ‡ recognized two distinct species (*S. Grubii* and *S. annulatus*) in the animals described by the above-named naturalist, and subjected these to a very thorough investigation. The second genus which must be referred to the group of the Seisonidæ was first described by P. J. Van Beneden § and C. E. Hesse under the name of *Saccobdella*. One of the species discovered by these naturalists, *Saccobdella nebalie*, was erroneously placed by them with the Hirudineæ, and Claus first referred it to its proper place in the neighbourhood of the genus *Seison*. As, however, the two representatives of the latter differ considerably in the form of the body from *Saccobdella nebalie*, their generic distinctness must be maintained, and it seems to me incorrect to cite the animal described by the Belgian naturalists as a distinct species of the genus *Seison*. How far the internal organization of *S. nebalie* agrees with that of the true Seisonidæ cannot at present be decided, as our knowledge of that Rotatorian is still imperfect and in many points pressingly requires confirmation. The genus *Seison* also needs further investigation, because with regard to the sexual and excretory apparatus many questions still wait for a definitive solution. This circumstance induced me to devote a short sojourn at the Zoological Station at Naples in the spring of 1886 to the study of this interesting group of animals.

* Translated from the 'Mittheilungen aus der zoologischen Station zu Neapel,' Bd. vii. pp. 234-263.

† E. Grube, 'Ein Ausflug nach Triest und dem Quarnero,' Berlin, 1861, pp. 19 and 109-115.

‡ C. Claus, "Ueber die Organisation und die systematische Stellung der Gattung *Seison*, Gr.," in the Festschrift zur Feier des 25-jährigen Bestehens der k. k. zool.-bot. Ges. in Wien, 1876; and "Zur Kenntniss der Organisation von *Seison*," in 'Zool. Anzeiger,' 1880, no. 68.

§ Van Beneden and Hesse, 'Recherches sur les Bdelloides ou Hirudinées, et les Trematodes marins,' Brussels, 1863, pp. 48 et seqq.

To my astonishment I found upon the *Nebaliæ* of the Bay of Naples, with which I was most abundantly provided, not the same genus which Claus met with on the Phyllopods of Trieste, but another one, differing from it in many respects; but as it agrees in most of its characters of organization with *Seison annulatus* and *Grubii*, it may in future bear the name of *Paraseison*. Its description forms the subject of the following pages.

In all I have seen four species of *Paraseison*, of which, however, only one was to be met with in comparative abundance on *Nebaliæ* from the middle of March to the middle of April; the other three, on the contrary, were so rare that, with all my efforts, I was only able to study one or two living females of any of them. I will commence with the common species:—

1. *Paraseison asplanchnus*, sp. n.

Even this species was not particularly plentiful during my residence in Naples; on the average only each fourth or fifth *Nebalia* was infested by parasites, and it was seldom that more than two or three adult individuals occurred together on the same host. I have no doubt, however, that at a more advanced season of the year these Rotatoria become more numerous, as their abundance was slowly increasing during the time that I was able to observe them. Reproduction seems to be reduced to a very small amount during the winter months, for at the commencement I found only old adult individuals, while later on ova and newly hatched examples were frequently observed. Female animals were always present in greater number than males, but the proportional abundance of the two sexes was by no means so extreme as in the fresh-water Rotatoria; generally there was one male to six females. The animalcules attach themselves, like the true *Seisonidæ*, by preference to the branchial laminae; but they also creep about upon all the other regions of the body. They attach themselves by means of an adhesive mucus, which is secreted from a number of pedal glands, by the posterior pole of the body to their point of support; and as we not unfrequently see, near the point of attachment of a female, several ova lying together in different stages of development (in one case I observed eleven in one mass), it seems to me probable that

the adult animals often remain seated for a long time in the same place, or at least that they limit their locomotion within very small distances.

The most essential distinction which exists between the genera *Seison* and *Paraseison* on the one hand, and the numerous genera which I have classed together as "Ductifera" in a recently published memoir* on the other, is this, that only in the latter does a marked sexual dimorphism occur, while it is wanting in the former. In the *Seisonidæ* males and females are approximately of the same size, and the difference of the two sexes finds expression only in the sexual apparatus and, in connexion therewith, also slightly in the secretory organ and muscular system; all the other organs are of the same nature in both.

A glance at Pl. VI. fig. 1 shows us the external habit of the animal. The body is divided into four distinctly marked sections, which, as in the genus *Seison*, may be characterized as head, neck, middle-body or trunk, and abdomen or tail. The neck and tail have a cylindrical form, while in the two other sections the sides of the body are considerably broader than the dorsal and ventral surfaces. The females in the adult and fully extended state are of an average length of 0.9–1.1 millim.; the males are rather smaller, attaining only 0.4–0.7 millim. As, however, both the neck and the tail are composed of apparent segments which can be invaginated one within the other, and, further, the whole neck is frequently retracted within the trunk, the *Paraseison* may acquire a much smaller length of body. When an adult individual is completely extended the abdomen is the largest section of the body; the trunk and neck are rather shorter, but nearly equal to one another. The foremost section is two thirds of the length of these. For systematic purposes such relative sizes may be of importance, and therefore the measurements of an old female example are here given in millim. :—

Total length 1.1; tail 0.34; trunk 0.27; neck 0.28;
head 0.19.

Width of neck at anterior end 0.016.

„ „ posterior end 0.04.

Greatest breadth of trunk seen from the side 0.104.

Breadth of tail at the base 0.06.

„ „ posterior extremity 0.02.

* L. Plate, "Untersuchung einiger an den Kiemenblättern des *Gammarus pulex* lebenden Ectoparasiten," in Zeitschr. f. wiss. Zool. Bd. xliii. p. 229 (1886).

Before proceeding to the detailed description of the different organs, we may, for the purpose of orientation, in the first place glance at the general organization of *Paraseison*.

The *head* agrees very little with the image which the typical Rotatoria present of this part of the body, as it displays no trace of a wheel-apparatus composed of motile cilia. Looked at from the side it has a lenticular form; broadest in the middle, it tapers off before and behind, bears the small buccal aperture (fig. 1, *o*) at its anterior pole, and contains in its interior a complicated masticatory apparatus (*ma*), a slender œsophagus (*œ*) opening dorsally into this, and a large ganglion (*g*), which may be regarded as the brain. The *neck* consists of three segments separated by annular grooves in the cuticle, of which the anterior can each be invaginated within that behind it, and which is traversed throughout its whole length by the œsophagus. Its width gradually increases from before backwards. The *middle-body* (*trunk*) is by far the broadest section of the whole body. In it we find the stomach (*st.*), which is closed cœcally, and consequently possesses no intestine and anus; dorsally or laterally to this are placed the paired sexual organs, the unpaired aperture of which is very differently placed in the two sexes. It is always situated on the dorsal surface, in the male at the point where the neck and trunk meet, in the female at that where the trunk passes into the tail (*a*). The *abdomen*, which follows, gradually becomes narrower posteriorly; it is composed of several apparent segments which can be pushed forward telescopically into one another, and which enclose a number of pyriform mucous glands (*f*), whose long efferent ducts open at the hinder pole of the body, and the secretion from which attaches the animal to its surface of support.

From a passing examination of the object it may seem doubtful which side is to be characterized as the back and which as the belly, especially if we start from the organization of the freshwater Rotatoria whose sexual organs are always placed ventrally. But from the position of the masticatory apparatus, the ganglion, and the sexual orifice it appears at once that the surface of the body regarded by me as the *back* really merits that name. In favour of this we have also the method adopted by *Paraseison* in locomotion. It creeps about after the fashion of a geometric caterpillar, attaching itself to its support by the head, curving the neck and trunk into a circle, and then attaching the caudal extremity quite close to the head. Then the head detaches itself again from the surface of support, the animal stretches itself to its full length, and repeats the same movement again and

again. Fig. 1 represents an individual engaged in wandering, and it shows at the same time that the side turned towards the support must be regarded as the *belly*.

The limitation of the four sections of the body distinguished in the preceding description cannot be followed out quite sharply, as they gradually pass one into the other. This applies especially to the two posterior divisions; it seems therefore advisable to reckon the foot as extending as far as the adhesive glands which give it its function extend forward (*f*). The female genital orifice then indeed falls within the region of the tail, which moreover is marked by a peculiar habit of the *Paraseison* during life. Thus, when the animal is disturbed or finds itself in an uncomfortable position, *e. g.* on the object-slide, the body almost invariably forms an angle, usually representing nearly a right angle, one limb of which is formed by the tail alone; its apex, as shown in fig. 1, is situated a little above the sexual aperture (*a*). This singular position is explained anatomically by the fact that the principal muscles of the trunk and abdomen meet in the region of this apical point, and it is further evidently connected with the absence of a rotatory apparatus, which compels the animal to seek its nourishment by feeling about with its head upon the support; it presents a peculiar spectacle to see the disproportioned animalcule in a bent posture stretching its long swan-like neck in all directions, and every moment retracting it completely into the trunk.

After this introductory glance at the structure of *Paraseison asplanchnus* we may pass to a more detailed description of the different organs. I commence with the general covering of the body.

The Skin.—This possesses all the properties characteristic of the body-wall of the freshwater Rotatoria. It consists of a thin hyaline cuticle, which is coated internally with a delicate protoplasmic matrix-layer, in which small nuclei with a large nucleolus are scattered here and there. This *hypodermis* is in parts so extraordinarily thin that we can only detect it with very high powers. Nevertheless it could be demonstrated everywhere, and probably therefore the species of *Seison* also present the same character, although Claus observes that “subcuticular traces are retained only in a few places in the form of granular pads.” At the extreme apex of the head, close to the buccal aperture, the matrix of *Paraseison* becomes thickened into pads, evidently the rudimentary homologues of the cephalic pads bearing the rotatory apparatus in the freshwater forms. Special *cutaneous glands*, such as are said to occur in *Seison*, are quite absent in our animal,

unless we are to interpret as such a pyriform thickening of the hypodermis situated in the tail in the median dorsal line. The *cuticle* is not of homogeneous constitution throughout, but presents some remarkable conditions of structure. In the segments of the neck we find a very delicate longitudinal striation (fig. 2) formed by many parallel lines, and which, spreading out like a brush, also extends upon the posterior part of the head. Instead of this there is, upon the posterior parts of the trunk, an apparent granulation, which also covers the whole of the foot. As we see by considering an ideal transverse section at the margin of the body (fig. 3), this is produced by small rounded or elongated hollow spaces which are placed close together, and frequently, arranged in longitudinal rows, traverse the inner part of the cuticle. If the punctuation of the tail be carefully examined, it is seen that on the two hindmost apparent segments it suddenly becomes much weaker than on the preceding ones. Further, the skin of the penultimate caudal ring is distinguished by the possession of a striation which is very noticeable. Four sharply marked lines run parallel to each other and not far apart from the dorsal towards the ventral surface and obliquely from before backward (figs. 1 and 7). Those of the right and left sides do not meet in the median dorsal line, but leave between them a narrow band of the ordinary texture. The ventral surface of the same segment bears the aperture of a peculiar organ, which also occurs in *Seison*, but for which I cannot with certainty indicate a homologue in the other Rotatoria. Claus says of it (*l. c.* p. 82):—"A pretty strong efferent duct opens in front of the adherent disk, on the convexly curved ventral surface of the terminal piece, upon a small conical tubercle." It is a small roundish vesicle, composed (it seems to me) of a structureless membrane, and it opens by a short duct projecting a little beyond the rest of the skin (figs. 4 and 7, *x*). Frequently it was tensely filled with a limpid fluid, whilst at other times the walls lay loosely in contact. With all my efforts I have never been able to observe any contractions of it, and therefore believe that none take place. In the freshwater genera *Monocerca* and *Diurella** the adhesive glands of the foot are converted into vesicles with contractile walls, which can suddenly evacuate their secretion. Possibly we have here to do with a corresponding arrangement which has become *rudimentary*, and then this organ would have to be regarded as a modified pedal gland,

* L. Plate, "Beiträge zur Naturgeschichte der Rotatorien," in *Jenaische Zeitschr. f. Naturw.* Bd. xix. N. F. xii. pp. 50, 51.

a view which acquires the more probability because we not unfrequently see a viscid drop adhering to the orifice of the efferent duct.

The description of the *adhesive glands* of the foot may perhaps be best appended to that of the skin, as they undoubtedly represent particularly strongly developed portions of the subcuticular matrix. There are about six to eight glands, each possessing a very long efferent duct traversing the abdomen (figs. 1 and 7, *f*). The further the cell producing the viscous slime is moved from the posterior pole of the body the longer is its efferent duct, which contains a great number of granules. The foremost viscous glands, which are placed at the level of the female sexual aperture or even still further forward, have several nuclei which belong to separate cells; those situated further back, on the contrary, are uninuclear. The efferent ducts of the different glands run, without uniting, to the caudal extremity, the peculiar construction of which may be seen from fig. 4. It forms a rounded tubercle, the periphery of which is beset with a number of small denticles placed in a row, and thus resembles the cog-wheel of a machine. The mucus secreted by the glands is pressed out through these prongs, by which means it frequently acquires the form of short threads lying side by side. It is not always easy to convince one's self of the construction of the posterior extremity of the body, as, like the posterior apparent segment itself, it can be introverted. When this is the case an adherent disk with thickened margins seems to close the caudal extremity, which, according to Claus, is actually the case in *Seison*.

The *alimentary organs* consist of three sections—the buccal cavity with the masticatory apparatus, the oesophagus, and the stomach. The anterior extremity of the head may be somewhat drawn in, and the small *buccal aperture*, situated at its extreme apex, is therefore not always equally visible. When we look down upon it from above, which, indeed, we seldom have the opportunity of doing, we observe that around it stand four tufts (fig. 5, *t*) of small rigid setæ, which are never moved, and evidently serve only for tactile purposes. We shall perhaps not be mistaken if we regard these as the last rudiments of the *rotatory apparatus*, which is retained in a more distinct form in *Seison* and in *Paraseison ciliatus*, hereafter to be described. From the side, of course, we see only two [bundles of] tactile setæ (fig. 6, *t*), and even these become inaccessible to observation, when the fore part of the head is more or less introverted. The buccal aperture itself has a rounded form only when the masticatory apparatus is

at rest; at each movement of the maxillæ it is, on the contrary, more or less elongated transversely. It leads into a short, canaliform, buccal cavity, into the bottom of which project the denticles of the mastax, which, dorsally, enclose between them the orifice of the œsophagus (fig. 6). At the first glance it seems as if the masticatory apparatus in *Seison* and *Paraseison* lay in a special appendage of the œsophagus, and thus differed from the condition in the freshwater *Rotatoria*; but as, in the latter, the œsophagus likewise always opens dorsally into the masticatory apparatus, although usually towards the middle or the hinder end of it, there is, in these genera, only a considerable displacement forwards of the œsophageal aperture.

The *masticatory apparatus* forms two divisions—the teeth, which project forward into the buccal cavity, of which two pairs are present (fig. 9, I. and II.), and a supporting apparatus, bearing these, and placed further back (figs. 8, 9, *a*, *β*, *γ*). The latter consists of three pairs of rather large chitinous ossicles, of which the middle one (*a*) far exceeds the others in length, and therefore at once catches the eye. It forms two thin spatuliform laminæ, much narrowed in their anterior half, where they unite to form a single pointed rod, as is best seen by examination from below (fig. 9). At the posterior extremity the two laminæ certainly lie very close together, but by a fine median line they show the original double nature of the whole structure. The broad surfaces of the laminæ bear about nine longitudinal costæ, which are strongly marked posteriorly, but terminate in front in extremely delicate lines. To the right and left of this median piece (*a*) of the supporting apparatus lie two ossicles, one of which (*β*) bends somewhat outwards and downwards, and the other (*γ*) in a large curve upwards; this latter dorsal member does not extend quite so far backwards as the ventral one, of which it must further be mentioned that its posterior extremity is widened like the bowl of a spoon, while the anterior end curves slightly outwards and is directly applied to one of the teeth. At the point where the chitinous pieces *γ* and *β* meet there is also a small rib directed backwards (fig. 9, *δ*). The two pairs of teeth, which are firmly united with the above-described supporting pieces and are moved by them, are of different forms. Two teeth form little rods, which fork into two short points at the anterior end (fig. 9, I.). They are supported by the pieces indicated by *γ*. The two other teeth are stout, elongate, ovate structures, which abruptly become narrower in front. The reciprocal movement of these teeth is effected by stout muscles, which spring from the costæ of

the spatuliform median laminae and are inserted upon β and γ . In the individual represented in fig. 9 these muscles were contracted, by which means the anterior extremities of β and γ , and therefore also the denticles, were drawn apart, whereas in the resting state of the muscles they are very closely approximated. Between the ossicles of the supporting apparatus the efferent ducts of the ventral *salivary glands* (fig. 9, dr') may be traced to the denticles, the action of which they assist with their secretion.

A little in front of the masticatory apparatus there lies upon the dorsal surface of the buccal cavity a small rounded body (figs. 5, 6, y), which, in the living animal, is always remarkable by its yellowish-green colour. On closer examination this proves to be composed of several (probably four) small bacilli, which are only slowly destroyed by solution of potash and dilute sulphuric acid, and therefore appear to be of a chitinous nature. Two of these bacilli are rather longer than the others (0.016 millim.) and terminate at one end in a fine, somewhat bent point. As to the significance of these structures I have been unable to arrive at any conclusion. As two pyriform unicellular glands, furnished with a very long efferent duct (fig. 6, dr^2), which lie dorsally to the oesophagus and right and left of the cerebrum, open between them, they are probably functionally related to these. I regard these organs, which likewise occur in the same way in *Seison*, as *viscous glands* of the head, fulfilling the same office as the pyriform cells of the foot. In fact, whenever a *Paraseison* creeps about upon the object-slide, attaching itself alternately by the anterior and posterior poles of the body, we find at the spots where the head was fixed a shining jelly, which has evidently served for the attachment of the animal, and is very probably secreted by the glands above described. On the other hand, two other glands (fig. 6, dr') must be interpreted as *salivary glands*; these, which are of the same structure as those just referred to, lie ventrally to the mouth and open immediately between its teeth.

The *oesophagus* (figs. 1, 2, 6, ω) forms a narrow tube, of equal width throughout, which traverses the entire length of the head and neck and on approaching the dorsal surface of the stomach passes into it. It is formed of a delicate membrane, in which I could recognize fine muscular fibres but no nuclei. In opposition to most *Rotatoria* we find its inner wall not lined with cilia, and the food taken will therefore certainly be conveyed backward by a sort of peristaltic movement, as is also the case, for example, in the *Synchaeta* and *Asplanchna*. The anterior extremity of the oesophagus very often shows

an undulately denticulate inner wall, a peculiarity which is probably to be ascribed to the muscles there situated. Soon after its entrance into the neck the œsophagus receives on each side the efferent duct of an elongate-pyriform unicellular gland (fig. 6, *dr*³), which extends into the head and evidently represents the "5-6 flask-shaped cells" which are said to occupy the same position in *Seison*. To the third segment of the neck belong two (or more?) small glands (fig. 2, *dr*⁴), which likewise discharge into the œsophagus and by their secretion facilitate the downward passage of the food.

The *stomach* (figs. 1, 2, 13, *st*) forms an elongated sac, cœcally closed behind, which is formed of large polygonal cells. The latter are arranged in irregular longitudinal series, and, in a well-nourished individual, densely packed with brown pigment-particles. If the animals be allowed to starve for a time, these disappear, and in an individual just escaped from the egg they are not yet developed. It is remarkable that the cells bear no cilia on the inner surface, a condition which, so far as I know, has not hitherto been observed in any other Rotatorian. It is, indeed, often difficult to detect the delicate cilia in the stomach of the Rotatoria; but I have definitely convinced myself of their absence in many very favourable animals. Indirectly the correctness of this statement is confirmed by another observation. Thus, in the lumen of the stomach there are frequently a great number of oil-globules of different sizes, and these, when the stomach is perfectly quiescent, remain quite motionless, even when they lie close to the wall, which would be impossible if motile cilia were present. Claus also noticed no vibratile movement in *Seison*. At the anterior end of the stomach, above the point of entrance of the œsophagus, two glands come in, which do not deviate from the ordinary structure of these organs. In the hinder wall the cellular coat of the stomach is somewhat thicker than elsewhere, but it does not allow the smallest trace of even a rudimentary intestine to be recognized. By the absence of this, *Paraseison* may easily be distinguished from *Seison*, as the latter, according to the last published observations of the Viennese naturalist, possesses, in both sexes, a rectum opening with the sexual apparatus. The *food* of *Paraseison* appears to me to consist chiefly of vegetable detritus and of particles of the eggs of *Nebalia* which have become decomposed; at least I often saw the stomach densely filled with a mass permeated by numerous fat-drops, which I regard as yolk. Probably the loss of the cilia of the stomach is to be ascribed to a readily absorbable form of food of this kind, standing in

need of no further division. I have never seen in our animal faecal matter of any kind.

The *female sexual organs* are situated, unlike those of all other Rotatoria, dorsally with regard to the stomach. They are two elongated sacs (fig. 1, *ov*), which, in adult animals, traverse the whole trunk, and open, about the level of the hinder extremity of the stomach, into a common efferent duct (fig. 1, *du*), which opens somewhat further back (*a*). This last point strikes one very easily as a transverse slit in examining the dorsal surface of the animal. When the sexual organs have grown to a certain size, they very frequently extend upon the sides of the body to the right and left of the stomach, and in rare cases I have seen an ovary, or both of them, by displacement, occupy the position characteristic of the other Rotatoria, ventral to the stomach.

Although the structure of the female sexual apparatus appears to be rather simple, I have not been able to arrive at perfect certainty about all its characters, which may be due to the fact that it is subject to different alterations, according to the maturity of the ova. In the condition which I have most frequently met with, a considerable number of ova are arranged behind one another and irregularly side by side to form a sac-like organ, and each of them is provided with a nucleus, which is distinguished by the possession of a very large nucleolus. The size of the ova by no means increases from before backwards, but large and small ova follow one another indiscriminately. At the anterior extremity of the whole organ there is, however, frequently a special aggregation of smaller ova, which are distinguished from the others by a much clearer vitellus, *i. e.* containing fewer fat-granules. We shall probably not be far wrong in ascribing these clearer ova to an early stage of development. All the ova of an ovarium are separated from each other by a distinct wall, and even on very careful examination show nothing in the shape of a membrane enveloping the whole ovary and continued into the efferent duct (fig. 1, *du*); nevertheless something of the kind must probably be present, and only escape observation by the fact of its clinging very closely to the ova, for how else should these ova, which are not firmly attached to each other, but change their relative positions and are frequently separated by gaps, be united into a special organ?

A somewhat different picture from that just described is presented by some individuals, in which the anterior parts of the right and left ovaries of the same female differ considerably. The apex of the left organ may be formed by a rounded body filled with a homogeneous mass of plasma,

in which numerous solid nuclei of different sizes are scattered. The three nuclei situated in the following section approach the ordinary form, which we see in the next section, by the possession of a nucleolus, although this is but small. The only remarkable deviation presented by the third section is that its plasma is not yet segregated around all the nuclei into separate ova. The ovary placed on the other side of the body in the same individual, on the contrary, showed nothing but distinct ova with nuclei of the usual form. One cell containing a remarkably large nucleus, appeared to be in process of division, at least the form of the nucleus and an annular constriction of the plasma led to this conclusion. The first section of the left ovary seems to indicate that the ova at first are not sharply separated from each other, but owe their origin to a germinal layer, and that a transformation of the nuclei goes on side by side with the development of separate ova. Perhaps, however, such a *germinal layer* does not occur in all individuals, but only in such as have left the egg comparatively early; at least, I have met with many young females in the ovaries of which all the ova were distinctly separated from each other. It must remain for future investigations to clear up completely the genesis of the female sexual products. In the developed ovary we do not always observe the contrast above-mentioned between aggregations of ova rich and poor in vitellus, but frequently all the cells are of the same structure.

The *extruded ova* are of very considerable size in proportion to the mother, and have an oval form pointed at one end (fig. 10). Their length is about 0.187 millim., with a maximum breadth of 0.06 millim. It is remarkable that the true ovum, the vitelline mass, only fills a little more than half of the cavity enclosed by the structureless egg-capsule, the rest of the space being occupied by a limpid fluid. In this I always found one or two rounded polar corpuscles of 0.007–0.015 millim. in diameter; these break up very slowly, so that we still find them with fully developed embryos. As a rule, only one polar corpuscle with a distinct nucleus was present, and this always lay in the fluid of the pointed half of the ovum; if a second had been formed it was always of smaller size. Only when the embryo approaches the end of its period of development it becomes so voluminous that it nearly fills the egg-capsule, even when, as appears to be always the case, the head and tail are folded up against the trunk. Owing to the abundance of yolk in the egg, it was impossible for me to ascertain the details of the development. The newly-hatched animals are about 0.39 millim. long and

fully developed, but the stomach only acquires its brown pigment by the inception of food. The ova lying in one mass are not all of the same sex, but among the preponderant number of female ova we find here and there a male one. As I often found only one female near such a breeding-spot, and indeed upon the *Nebalia* infested, it follows that the same animal may deposit ova of different sexes; and this merits notice because among the freshwater Rotatoria the individual produces ova only of one sex, either male or female*.

The *male sexual organs* of *Paraseison* are of very peculiar structure, and differ considerably in the corresponding organs not only from the species of *Seison*, but also from the other Rotatoria. Like the female sexual organs they are paired and placed dorsally with respect to the stomach. The testes form two pyriform organs (fig. 13, *te*), which traverse the greater part of the length of the trunk, and turn their wider end forward. Posteriorly they gradually narrow into an efferent duct, which is curved towards the back. They do not, however, always retain their position above the stomach, but frequently slip down on the two sides of it. They open into a rounded body (*x*), with regard to which, unfortunately, I was unable to ascertain much. It appeared to me to be paired, or at least divided by a groove into two lobes, and to stand in connexion with a large pyriform organ (*d. ej.*), which at once catches the eye. This sacciform structure becomes considerably narrowed and then opens upon the dorsal surface at the point where the neck and trunk pass into one another (*a*), and in this terminal portion it shows a delicate ciliation, which, however, lines the inner wall only for a short distance. The broad posterior end of this peculiar organ, which seemed to me to be formed of a structureless membrane, consists of a homogeneous mass which is traversed by two contorted ducts (*v. d.*) furnished with a ciliation striking backward; the latter open by two separate apertures into the cavity which lies before them. As to their exact course and their connexion with the body (*x*) which lies immediately behind them, I could arrive at no definite opinion, as in the living animal the investigation is rendered very difficult by its constant movements, and dead specimens are always so contracted that the parts in question are concealed.

The male generative organs of *Seison* do not differ from those of *Paraseison* just described so considerably as not to be comparable with them, and in accordance with this we have to regard that structure (*x*) in our animal which receives the efferent ducts of the testes as a *seminal vesicle* and the tor-

* See my previous memoir, *l. c.* p. 106.

tuous ducts (*v.d.*) as *vasa deferentia* which conduct the semen into the great cavity of the *ductus ejaculatorius* (*d. ej.*). Perhaps, indeed, there is only one *vas deferens* which possesses two anterior apertures.

The *testes* are often very difficult to find, especially when they lie immediately above the brown stomach. They are clothed with a delicate membrane, which contains in its interior many small cells, and in the mature state numerous active and very small *spermatozoa*. In each of the latter a head and a caudal thread may be easily recognized. In the testes of the freshwater Rotatoria, as is well known, besides the true spermatozoa, which resemble those just described, we find motionless bacilli, pointed at the two ends, of which the nature is doubtful. I have generally missed these in *Paraseison*, and only once observed an aggregation of bacilli (*y*) which might represent those just described. The *seminal vesicle* is filled with a finely granular mass, probably consisting of densely-packed spermatozoa.

The contents of the other parts of the generative apparatus are very remarkable. The *ductus ejaculatorius* contains a great number of flask-shaped corpuscles (figs. 11, 12, 13), averaging 0.014 millim. in length and 0.005 millim. in breadth, which are themselves incapable of motion, but of which some are not unfrequently driven by ciliary action into the *vasa deferentia*. In each flask we can distinguish three divisions, namely an anterior hemispherical cap (fig. 12, *a*), a somewhat narrower neck (*b*), and an ovate hinder portion (*c*), which is two or three times the breadth of the neck. The anterior and middle parts are clothed with a thin chitinous membrane, whilst the capsule of the last division is thick and firm. These conditions are best recognized by allowing a drop of solution of potash to act for a short time (fig. 11). We then see that the dark shining rod, which traverses the whole length of the neck, is not a canal, but a solid structure, which projects somewhat into the anterior and posterior pieces. The remainder of the neck is either without contents or occupied by a limpid fluid. In the anterior division of the structure under consideration there is a granular protoplasmic substance, which looks as if it consisted of a dense accumulation of spermatozoa. It is wanting in the immediate vicinity of the anterior end of the neck-axis, so that, as shown in fig. 12, it arches over this central rod like a hood; only a fine streaking is to be recognized in the clear space between the neck and the plasma. Whether the latter really consists, as I believe, of a closely entwined coil of seminal filaments I could not decide with certainty; no movements

could be observed in it. The posterior division also contains a finely granular mass, which, in general, does not completely fill the space assigned to it, and also frequently shows vacuoliform clear spaces. It is certainly different in its structure and nature from the substance of the head-piece.

So long as we have not succeeded in observing the action of the flasklets above described in the act of copulation we can only form suppositions as to their nature. I regard them as *spermatophores* which, under certain circumstances, set free the portion of semen contained in their anterior division. This opinion is supported by the following observation. Not unfrequently we find in the hinder termination of the *vasa deferentia* sperm-flasklets which have the anterior division still empty, but which are placed in the immediate vicinity of a mass of living spermatozoa, and therefore produce exactly the impression that they are about to take in a number of the latter. Unfortunately I did not notice whether such sperm-flasklets are or are not furnished with substance in their posterior cavity; but in my preserved material I found a young male with a spermatophore having no semen in the anterior, but with contents in the posterior division. Probably, therefore, this is formed by a turgescible mass, which, when in the body of the female, bursts the walls of the flasklet, and so renders it possible for the spermatozoa to amalgamate with the ova. The position which the spermatophores take up in the male animal is worthy of note. They are all, both in the *ductus ejaculatorius* and in the *vasa deferentia*, arranged more or less parallel to the longitudinal axis of the male, and always turn the head-end towards the posterior pole of the body of the latter (fig. 13). Where and how they are produced I was unable to ascertain, but they are certainly formed very early, as perfectly developed sperm-flasklets are to be met with in the interior of embryos still unhatched.

No spermatophores or structures which can be compared with these have hitherto been observed in the *Rotatoria*; even in *Seison* they do not appear to occur,—or are the small bacilli which also show a clear middle part and dark anterior and posterior divisions, and which, according to Claus, densely fill the *ductus ejaculatorius* and the terminal portion of the *vas deferens*, homologous although less perfect structures? The male sexual apparatus of *Seison*, however, differs considerably from that above described. Thus its *ductus ejaculatorius*, as stated by the Viennese zoologist, possesses two appendicular organs, a diverticulum on the right-hand side and opposite this a multipartite glandular body; further, the same organ presents a wall furnished with strong muscula-

ture, while in *Paraseison* this is either entirely deficient or very feebly developed; lastly, the testicular tubes in the species of *Seison* are placed ventrally to the stomach, in *Paraseison* beside or over it.

The copulation I have, unfortunately, been unable to observe; it would be interesting to find out something about it, as from the mere knowledge of the male genitalia we can scarcely form any idea of the process. That the *ductus ejaculatorius* is everted through its narrow aperture of exit is quite inconceivable, considering the entire absence of any musculature which could effect this. It therefore hardly merits this designation in *Paraseison*, whilst in *Seison* it may bear it with propriety. Several times, indeed, I had occasion to see how the sperm-flasklets were driven outwards into the anterior peduncular portion of the *ductus* by the cilia. From the absence of any organ having the function of a penis, copulation can only be effected by the juxtaposition of the sexual apertures, the different position of which in the two sexes must compel the copulating individuals to take up an unusual position with regard to each other. It is very remarkable that, notwithstanding the great number of animals that I have seen, I have never found spermatophores or spermatozoa in the female individuals.

The *water-vascular system* of *Paraseison* presents nearly the same constitution in both sexes, small differences only being produced by its union with the efferent ducts of the reproductive materials; from the typical structure of the same organ in the freshwater Rotatoria it differs by the possession of a long lateral canal with a cæcal termination. With the exception of the tail it traverses all the divisions of the body in the form of two tubes, which, however, are comparatively easy to find only in the trunk, whilst in the neck and head they are very liable to escape the notice of the observer, owing to their small calibre and transparent texture. In favourable specimens we see on each side, about the middle of the head (fig. 6, z^1), a faint undulatory movement, which is caused by a small cylindrical flicker-organ ("*Zitterorgan*"). This is seated upon a slender canal, which at this particular point forms some loops, and which may also be traced forward for some distance, although I could not succeed in discovering its anterior termination in the head. The continuation of this tube backwards traverses the whole neck and bears a second flicker-organ (fig. 6, z^2) at the transition-point of the head and neck. Throughout this space the lumen of the canal continues of equal width. When the vessel has passed into the trunk it approaches the ventral

surface and here forms a second coiled portion, which is furnished with a third flicker-organ (fig. 13, z^5). From this point it acquires a more considerable diameter, about five times as great as before, and in the male runs obliquely backwards and upwards to the posterior end of the sexual apparatus. As to the mode in which it unites with the latter organ, I have unfortunately no precise information. The aquiferous vessel seemed to me to open into the seminal vesicle, or a little before this into the testicular duct (fig. 13). In the female the secretion-canal only rises a little towards the back, and then runs backwards close and parallel to the stomach, opening into the efferent duct, which is common to both ovaries. Soon after this wide aquiferous vessel on each side has quitted the coiled-up portion situated at the commencement of the trunk, it emits, in both sexes, a slender lateral branch which runs backward along the ventral side of the animal (fig. 13, $w.g^1$), the lumen of which is not wider than that of the canal in the neck. At the point of passage of the trunk into the tail this branch forms a third coil lying close to the ventral side and connected with two further flicker-organs (fig. 13, z^4, z^5). In some *Asplanchnæ*, the aquiferous vessels of which also fork, the branches unite again before opening into the contractile vesicle, and thus form a loop. I therefore supposed that in *Paraseison* also there might be present a tubercle issuing from the hindmost looping and returning to the main canal; but this was not to be found, and consequently the canal $w.g^1$ seems to terminate cæcally here. The five flicker-organs on the right and left sides which appear to be proper to *Paraseison* show no remarkable peculiarities in their structure. They are small, cylindrical, posteriorly closed tubules, with a cilium vibrating within them; a broad, superficial, and narrow edge-view, such as we meet with in so many other Rotatoria, is not distinguishable here. The wide main canal of the trunk has only a narrow lumen, but a thick wall charged with many granules and vacuoles. Frequently the fluid-vesicles lie close behind one another, like the beads in a necklace. The same finely granular, gland-like constitution occurs also in the coiled parts; while the narrow canals in the head, neck, and trunk are clothed with a delicate almost structureless membrane.

The structure of the secretory apparatus described above is interesting, because it deviates from the typical construction of this organ by the want of a contractile vesicle and by the development of particular parts into mere conveying-ducts and of others into secretory divisions; at least it appears to me

that the differentiation into nearly smooth and thin, and into finely granular thick vessels, certainly indicates such a division of labour. The water-vascular system of *Seison*, so far as one can judge from the extant investigations, is not quite so developed as in our animal. There is said to be only one flicker-organ, which represents that indicated by me as z^3 , and in the trunk only one wide canal, which latter, "ascending to the intestine," passes into "a delicately membranous saccule lying upon this."

The *connective tissue* is represented in *Paraseison* by a few thin threads, which extend between the organs and the skin. Of the animal organs,

The *nervous system* has become very little known to me. Above the anterior extremity of the oesophagus there is in the head an elongated organ, somewhat pointed in front and terminating broadly behind, the *brain* (fig. 6, *g*), in which, by means of reagents, the presence of numerous nuclei with comparatively large nucleoli may be demonstrated. This is connected posteriorly with a dorsal feeler (fig. 6, *d.t*), the setæ of which arise from a circular aperture in the skin. Their size is very variable in different individuals; frequently they are very long and easily recognizable, while in other individuals they are remarkable for their smallness. To the nervous system, no doubt, belong also the four groups of tactile setæ (figs. 5, 6, *t*) which surround the buccal aperture; but I was unable to ascertain their connexion with the brain. Lateral feelers, which are so characteristic of the freshwater *Retatoria* with the exception of the *Philodinæa*, are wanting in *Paraseison*. No eye-spots were seen.

The *muscular system* is difficult to observe in its details, owing to the constant mobility of the living animal. The longitudinal musculature is especially developed; whilst of the scantily developed transverse bands we need mention only three tolerably broad muscles, which lie at equal distances apart below the dorsal surface of the trunk and extend over the dorsal half of the sides of this division. The system of thin transverse muscles covering the whole ventral side of the trunk, which is so characteristic of *Seison*, is entirely deficient in *Paraseison asplanchnus*.

Of the *longitudinal muscles* those are of course the most important which, on the one hand, retract the neck into the trunk and, on the other, the hindmost segments into the basal part of the tail. During invagination the neck always comes to lie near the ventral surface, below the stomach, as the muscles which act in this operation are nearer to the lower surface of the body than to the back. These are two strong bands

(fig. 1, m^4), smooth (like all the muscles), which traverse the trunk on each side and can be traced into the third segment of the neck. They originate somewhat behind the middle of the trunk, and are continued backwards in it on each side by two closely approximated muscles (fig. 1, m^5). If we examine *Paraseison* from the ventral surface we see, outside of the contractile bands just described, on each side another one of smaller size, which, however, traverses only the anterior half of the trunk. Within the neck-retractors, marked m^4 , there are further two thin muscles, which commence at the base of the neck and penetrate deeply into the tail near the median line. Of the *retractors of the caudal segments* there are two on each side especially developed, the course of which may be seen in fig. 1, m^8 and m^6 . How far they extend posteriorly I have omitted examining. Dorsally from these, two bands are extended on each side, of which one (m^7) is delicate and short, while the other (m^9) consists essentially of two muscles, which meet together at an angle, and of which the anterior one is distinguished by its shortness and breadth. Besides those mentioned above, the tail contains some other muscles, which serve to introvert the hindmost segments. Thus we have the band indicated by m^{13} in figs. 4 and 7 (which possibly forms a continuation of m^8 or m^6), as also m^{14} and m^{15} . The great muscle traversing the trunk (m^1), which is inserted in the middle of the third ring of the neck, is followed anteriorly by m^2 (fig. 2), the anterior point of attachment of which is at the base of the head. This muscle draws back the first two neck-segments, and is assisted therein by the smaller bands (fig. 2, m^1 and m^3), the position and arrangement of which is shown in the figure. All the longitudinal muscles just described are in pairs, and symmetrically arranged to right and left. This applies also to the three short adductors which introvert the most anterior part of the head. Two of these (fig. 6, m^{10} and m^{11}) lie above the masticatory apparatus, the third pair (m^{12}) below it.

Having described as accurately as possible the organization of *Paraseison asplanchnus*, the description of the other three species of the same genus which occur on the *Nebalica* of the Bay of Naples may be managed with few words, as, except in a few particulars, they perfectly agree with the above species.

2. *Paraseison nudus*, sp. n.

This form is distinguished especially, so far as I could see, by the entire absence of the four groups of tactile setæ which, in the ordinary species, surround the mouth; consequently, in

this species no trace of the rotatory organ has been retained—a phenomenon which is one of the greatest rarities in the class Rotatoria. Further, the head is somewhat different in form from that of *P. asplanchnus*, inasmuch as it is much attenuated in front, so that the buccal aperture is situated at the apex of a small cone. This species is much scarcer than *P. asplanchnus*, and I have seen only two female examples of it. The measurements of one of these were as follows:—Head 0·12, neck (almost extended) 0·12, trunk 0·18, tail 0·2.

3. *Paraseison proboscideus*, sp. n.

Also, like the preceding species, possesses no buccal feelers, but, on the other hand, the head is characterized by the presence of a small naked proboscis, which is situated above the buccal aperture and appears to act as a tactile organ. I think I have observed that this proboscis was connected by a delicate cord (canal?) with the yellowish-green body which I have already mentioned in *Paraseison asplanchnus*. The masticatory apparatus differs somewhat in form from that of the common species. In the musculature surrounding it we observe some bands, arranged transversely and parallel to each other, which never caught my attention in *P. asplanchnus*. When fully extended, the single female that I have observed measured about 0·76 millim.

4. *Paraseison ciliatus*, sp. n.

This species I have only twice seen living, but have often been able to examine in preserved material. In some points it greatly resembles *Seison Grubii*, Claus, so that at first I was in doubt whether it might not be identical with that form. Like the species in question it has, on each side, to the right and left of the buccal aperture, a strong tuft of cilia, by the rapid movement of which the animal's food is swept in. There are, however, no tactile setæ in the vicinity of the mouth. A further agreement with the true *Seisonidæ* is to be found in the fact that the matrix of the cuticle shows two streaks of changed constitution on the two sides of the ventral surface of the trunk. Each of these longitudinal bands is about 0·017 millim. in width, and bears a great number of transverse, parallel, and very delicate fibrils, between which comparatively numerous nuclei are placed. These transversely striated parts extend in the species of *Seison* over the whole ventral surface of the trunk, while in our animal they enclose between them the greater part of it unaltered in

structure. In all other peculiarities of organization, however, there prevails a complete agreement with the above-described species of *Paraseison*; there is no intestine, the water-vascular system forks in the trunk into a broad and a narrow branch, in the hinder part of the head there are only two pyriform glands, which open into the cesophagus at the commencement of the neck, and in the so-called *ductus ejaculatorius*, the wall of which shows no musculature, there are a number of the flask-shaped structures which have been regarded as spermatophores. The masticatory apparatus and the dimensions of different divisions of the body are also as in *P. asplanchnus*.

5. On the *Systematic Position of the Seisonidae, and the Natural Groups of the Rotatoria.*

The new genus *Paraseison* described in this memoir certainly differs from the previously known genus *Seison* in many particulars; but these are of so slight a nature that no doubt can exist as to the close relationship of the two forms. A fresh investigation of the ectoparasites occurring on *Nebalix* near Trieste will probably also furnish evidence of some things hitherto found only in *Paraseison*, such as the dorsal feeler, a greater number of flicker-organs, and a ventral branch of the part of the water-vascular system situated in the trunk. As to the position which the genus *Saccobdella* occupies with regard to these two genera further investigations must decide, as our knowledge of this animal-form is at present very imperfect, and we can only unite it provisionally and hypothetically with *Seison* and *Paraseison*, in the family Seisonidæ. The relations of this group to the other Rotatoria will be elucidated in what follows.

In my recently published memoir on some ectoparasites of *Gammarus pulex* I have attempted to show that the known freshwater Rotatoria fall under two natural subdivisions, which differ from each other in the general form of the body and in many peculiarities of organization. The most important contrast is manifested in the structure of the female generative organs. In one group, that of the *Aductifera*, or Philodinææ, these are paired, possess no efferent ducts, and are composed of a homogeneous plasma-mass permeated by nuclei*, definite portions of which are gradually constricted off, and fall, as ova, into the body-cavity. In the other group, the sexual organs are unpaired, but are formed of two sections having different functions, one of which (ovary) contains the cells

* See the supplementary note at the close of this Memoir.

which are in process of growth into ova, while the second (vitelligene) merely furnishes the nutritive material necessary for development. This family of the *Ductifera*, to which by far the greater number of genera belong, possesses a special duct for the reproductive materials opening in the back. The nervous system presents a further decided distinction between the two divisions. The *Ductifera* always* present two lateral and one or two dorsal tufts of tactile setæ, while in the *Philodinæ* only the latter occur. The *marine* *Rotatoria* also, upon which, however, we have no recent investigations, enter without violence into these natural groups, so far as I can judge from the examination of certain genera (*Brachionus*, *Pterodina*, *Colurus*, *Synchaeta*, *Furcularia*, and *Philodinæ*), as they only differ very slightly from their allies in the fresh water. But the three genera parasitic on *Nebalia* differ so much from all other *Rotatoria* that in opposition to these they must be united into a third family. Undoubtedly, however, the *Seisonidæ* come nearer to the *Philodinæ* than to the *Ductifera*. With the former they share the elongate worm-like form, and the faculty of pushing the foremost and hindmost apparent segments into one another in telescope fashion. The adhesive organ of the tail is formed in both sections by a considerable number of glands, while the *Ductifera* only possess two, or have lost them altogether; and further, in the nervous system, the absence of the lateral feelers is common to them. As the primitive construction of the rotatory apparatus of the *Philodinæ* renders it probable that this family has retained comparatively many of the characteristic peculiarities of the original form of the entire class, we may also assume that the *Seisonidæ* branched off comparatively early from the genealogical tree of the *Rotatoria*. A further conclusion arising from this (which, however, like all such phylogenetic speculations, must, of course, be taken with the necessary reserve) would then be that the female sexual organs of the *Rotatoria* were originally paired, and consequently the unpaired sexual apparatus of most members of the class is to be regarded as something acquired secondarily. This view is supported by the structure of the sexual organs in *Pterodina patina*, Ehr., a species whose genus (as I have previously indicated) is one of the few *Ductifera* in which several primitive peculiarities of organization have been preserved; the *Pterodinæ* have the simple two-rowed rotatory apparatus of the *Philodinæ*, their water-vascular system has not yet developed any contractile vesicle, and the long tail terminates with the same tuft of cilia which characterizes the young forms of the

* To this *Conochilus* is an exception.

Ductifera which are sessile when adult (*Lacinularia*, *Melicerta*, and their allies). They have further a horseshoe-shaped vitelligene, each limb of which bears an ovary of the usual construction at its posterior end, that of the left side of the body being feebly, and that of the right side more strongly developed, and the latter alone seeming to function. This doubling of the ovary renders it very probable that the two limbs of the vitelligene were also originally separate, and only became united subsequently. A vitelligene so constructed, indeed, still occurs in some species of the genus *Asplanchna*, which in other respects differs greatly from *Pterodina*. Here the limbs of the organ are so long in proportion to the part uniting them, that one is involuntarily driven to the assumption of their original duplex nature, although the ovary, which is placed at the apical point of the two limbs, is unpaired. The two genera just named, therefore, as regards the structure of the female sexual organs, facilitate the passage from the two older families of the Philodinæ and Seisonidæ to the more modified younger family of the Ductifera.

This view as to the phylogenetic development of the natural groups of the Rotatoria meets only with one difficulty. The masticatory apparatus of the Seisonidæ closely approaches the typical structure of this organ in the Ductifera, but differs considerably from that of the Philodinæ. According to Gosse*, one can distinguish in the mastax of the majority of the Rotatoria a central "incus" composed of two "rami" and two lateral "mallei," parts which may also be recognized at once in *Paraseison*. In the Philodinæ, on the contrary, these ossicles are fused together into two ribbed masticatory plates, which also reappear in exactly similar development in many Melicertidæ. These facts admit two hypotheses for their explanation; either the biting-organs of the *Archirotdator* were like those now presented by the Philodinæ, and developed themselves therefrom, independently of each other, in two different sections; or, and I regard this as more probable, they showed from the beginning the structure still existing in the majority of the Rotatoria, from which, then, the two masticatory plates which we now find in the Philodinæ and some Ductifera were produced by the growing together of the chitinous bands belonging to each half of the body.

In conclusion, a condensed summary of the most important anatomical points for the distinction of known genera and species of the family Seisonidæ may here follow: as a matter of course it represents only the present standpoint of our

* Gosse, "Manducatory Organs of Rotifera," in Phil. Trans. 1856.

knowledge, and will, perhaps, very soon have to submit to alterations.

Characters of the Family Seisonida.

Elongate, vermiform animals, $\frac{1}{2}$ –3 millim. in length, of similar form in both sexes, so that the sexual dimorphism is expressed prominently only in the sexual apparatus. The males are somewhat smaller than the females and not quite so abundant. The *body* is divided into four sections composed of apparent segments, which are distinguished from before backwards as head, neck, middle body (trunk), and tail, and, with the exception of the last two, are sharply separated from each other. The neck can be retracted in its whole length into the trunk, to the ventral surface of which it is then applied. The *rotatory apparatus* is either present only in a rudimentary form, or altogether wanting. The long, narrow *œsophagus* opens into the anterior end of the masticatory apparatus, so that the latter forms a sacciform, ventral appendage of the œsophagus. In the *head* two dorsal and two ventrally situated, long-stalked, pyriform *glands*, which empty their secretion before the mastax or into it. Muciparous cells of the same kind exist also in the hind head and neck. *Stomach* elongated, with two glands at the anterior end, formed of large polygonal cells which bear no cilia within. *Sexual organs* paired, but with a common dorsal evacuator, which opens in the male at the point of passage of the neck and trunk, in the female at the posterior extremity of the trunk. The ovaries consist of numerous, distinctly separated ova, and are therefore not differentiated into ovary and vitelligene. The male sexual apparatus is of complicated structure, in which various parts, which are regarded as seminal vesicle, *vas deferens*, and *ductus ejaculatorius*, may be distinguished. Two *aquiferous vessels*, furnished with “flicker-organs” traverse head, neck, and trunk, and discharge themselves externally with the sexual organs. Characteristic of these is (1) The development of some parts into thin-walled and of others into thick-walled canals; and (2) the absence of a contractile vesicle. To the nervous system belongs a ganglion placed dorsally in the head, and bearing a dorsal feeler. There are no lateral feelers. The *longitudinal musculature* is strongly, and that running transversely feebly developed; it is smooth throughout. The tail contains a number of long-stalked, pyriform, *viscous glands*, which open at the hindmost pole of the body. At the same point there is towards the ventral surface a vesicle opening by a short pro-

jecting canal, the signification of which is doubtful. The animals live ectoparasitically upon the species of *Nebalia* of the Mediterranean and North Sea, especially on their branchial laminae. They creep about after the fashion of geometric caterpillars, and deposit their ova in groups. At the commencement of development one or two polar corpuscles appear; all its stages are passed in the egg. Special persistent (winter) eggs do not occur.

Genus I. SEISON, Grube.

With an intestine, which discharges itself with the excretory organ, and therefore places the anal aperture in different parts of the body in the two sexes. Rotatory apparatus rudimentary, formed by two tufts of cilia placed at the foremost pole of the body. In the posterior half of the head 5-6 flask-shaped cells, the efferent duct of which passes into the fore part of the neck. The sexual organs of the female are placed ventrally to the stomach. The aquiferous vessels do not fork in the trunk. The *ductus ejaculatorius* of the male possesses a well-developed musculature in its walls, and performs undulatory movements. On the right side it forms a lobiform diverticulum, and opposite to this on the left side a multipartite glandular body. No spermatophores. The tail terminates posteriorly in an adhesive disc. The whole ventral surface of the trunk is covered with a great number of transverse muscular fibres, and thereby acquires a striated appearance. In the Adriatic near Trieste.

1. *Seison Grubii*, Claus.—Trunk not annulated; neck formed of three segments.

2. *Seison annulatus*, Claus.—Trunk divided into a large portion, and, following this, four short joints; the neck shows more than three rings.

Genus II. PARASEISON, gen. nov.

In both sexes *without intestine*. Rotatory apparatus either as in *Seison*, or reduced to a few tactile setae, or entirely wanting. In the hind-head only two flask-shaped glands, which open into the oesophagus in the commencement of the neck. Sexual organs in male and female placed laterally or dorsally to the stomach, only exceptionally displaced below it. Each aquiferous vessel with five flicker-organs, and giving off a thin-walled, caecally terminating lateral branch in the anterior part of the trunk. The *ductus ejaculatorius* of the male with smooth walls, with no movements or lateral organs, with numerous flask-shaped spermatophores. The tail does

not terminate with an adhesive disc, but the posterior pole of the body has the form of a hemisphere, which is beset with a row of small denticles, between which the viscous glands discharge themselves. In the Bay of Naples.

1. *Paraseison asplanchnus*, sp. n.—Average size of the adult female 1 millim. Without true rotatory apparatus, but with four tufts of tactile setæ standing round the buccal aperture.

2. *Paraseison nudus*, sp. n.—Size 0·6 millim. Head without any trace whatever of a rotatory apparatus, and also without buccal tactile setæ. It also becomes attenuated in front, so that the buccal aperture comes to be situated at the apex of a small cone.

3. *Paraseison proboscideus*, sp. n. Size 0·75 millim. Head without any trace of rotatory apparatus, without tactile setæ at the mouth, but with a small proboscidiform eversion of the skin, situated above the buccal aperture, which serves as a tactile organ. Rare.

4. *Paraseison ciliatus*, sp. n. Size about 1 millim. Assists in the transition to the genus *Seison*, inasmuch as the rotatory apparatus is developed as in that genus, and further there are, on the ventral surface of the trunk, two longitudinal streaks composed of numerous parallel muscular fibres. Not uncommon.

With these two better-known genera is to be arranged the still insufficiently investigated

Genus III. SACCOBELLA, Van Beneden & Hesse.

Saccobdella nebalia, Van Ben. & Hesse. Length 2–3 millim. The abdomen terminates in two pedunculate sucking-discs. Neck composed of five segments of about equal length, tail of four rings. Buccal aperture on the lower surface of the head, not far from the anterior margin. The intestine is said to traverse the whole body in the median line. Colour of the body a very light blue. The ova possess a small stalk, and several of them may be united to form a bush-like group. In the North Sea.

POSTSCRIPT.—The assertion formerly made by me (*Zeitschr. f. wiss. Zool.* Bd. xliii. pp. 230 *et seqq.*), and to which I have referred in the preceding memoir, that the sexual organs of the female Philodinæ are not divided into a germigene and a vitelligene, has recently proved to be a mistake. Soon after the completion of the manuscript of this memoir, I found the germigene in some Philodinæ which were better suited to

the study of this organ than the *Callidina parasitica*, Gigl., previously investigated by me. I can now, therefore, in this point fully confirm the descriptions of the germi-vitelligene since given by Tessin (*Zeitschr. f. wiss. Zool. Bd. xlv. pp. 273 et seqq.*) and Zelinka (*ibid. pp. 396 et seqq.*).

EXPLANATION OF PLATE VI.

All the figures relate to *Paraseison asplanchnus*, and the letters have the following signification:—

<i>a.</i> Aperture of the sexual organs.	<i>œ.</i> Œsophagus.
<i>d. ej.</i> Ductus ejaculatorius.	<i>ov.</i> Ovary.
<i>dr.</i> Glands of the head and neck.	<i>st.</i> Stomach.
<i>dt.</i> Dorsal feeler.	<i>t.</i> Buccal feelers.
<i>du.</i> Effèrent duct of the female sexual organs.	<i>te.</i> Testes.
<i>f.</i> Pedal glands.	<i>v.d.</i> Vas deferens.
<i>g.</i> Brain.	<i>wg.</i> Aquiferous vessel.
<i>m.</i> Muscle.	<i>x.</i> { Doubtful organs.
<i>ma.</i> Masticatory apparatus.	<i>y.</i> {
<i>o.</i> Buccal aperture.	<i>z.</i> Flicker-organs.

Fig. 1. Female animal, $\times 230$.

Fig. 2. Neck, $\times 275$.

*Fig. 3.** Section through the cuticle of the trunk.

*Fig. 4.** Hinder extremity of the tail.

*Fig. 5.** Anterior end of the head, seen in front.

Fig. 6. Head, $\times 550$.

*Fig. 7.** Tail.

*Fig. 8.** Masticatory apparatus seen from the side.

*Fig. 9.** Masticatory apparatus seen from below.

Fig. 10. Deposited ova, $\times 120$.

Fig. 11. Spermatophore after treatment with solution of potash.

Fig. 12. Spermatophore in the natural state.

Fig. 13. Trunk of the male, $\times 275$.

The figures marked with an asterisk have no indication of the amount of enlargement.

BIBLIOGRAPHICAL NOTICES.

A Flora of Hertfordshire. By the late A. R. PRYOR, B.A., F.L.S. Edited for the Hertfordshire Natural History Society by BENJAMIN DAYDON JACKSON, Sec. L. S. *With an Introduction on the Geology, Climate, Botanical History, &c. of the County,* by JOHN HOPKINSON, F.L.S., F.G.S., and the EDITOR. London: Gurney and Jackson, 1887. 8vo, pp. viii & 588.

To edit a botanical work by one like the late Mr. Pryor, whose work we have been led to expect would at least equal, if not